JOBS' NEXT GAMBLE: His UNIX Machine

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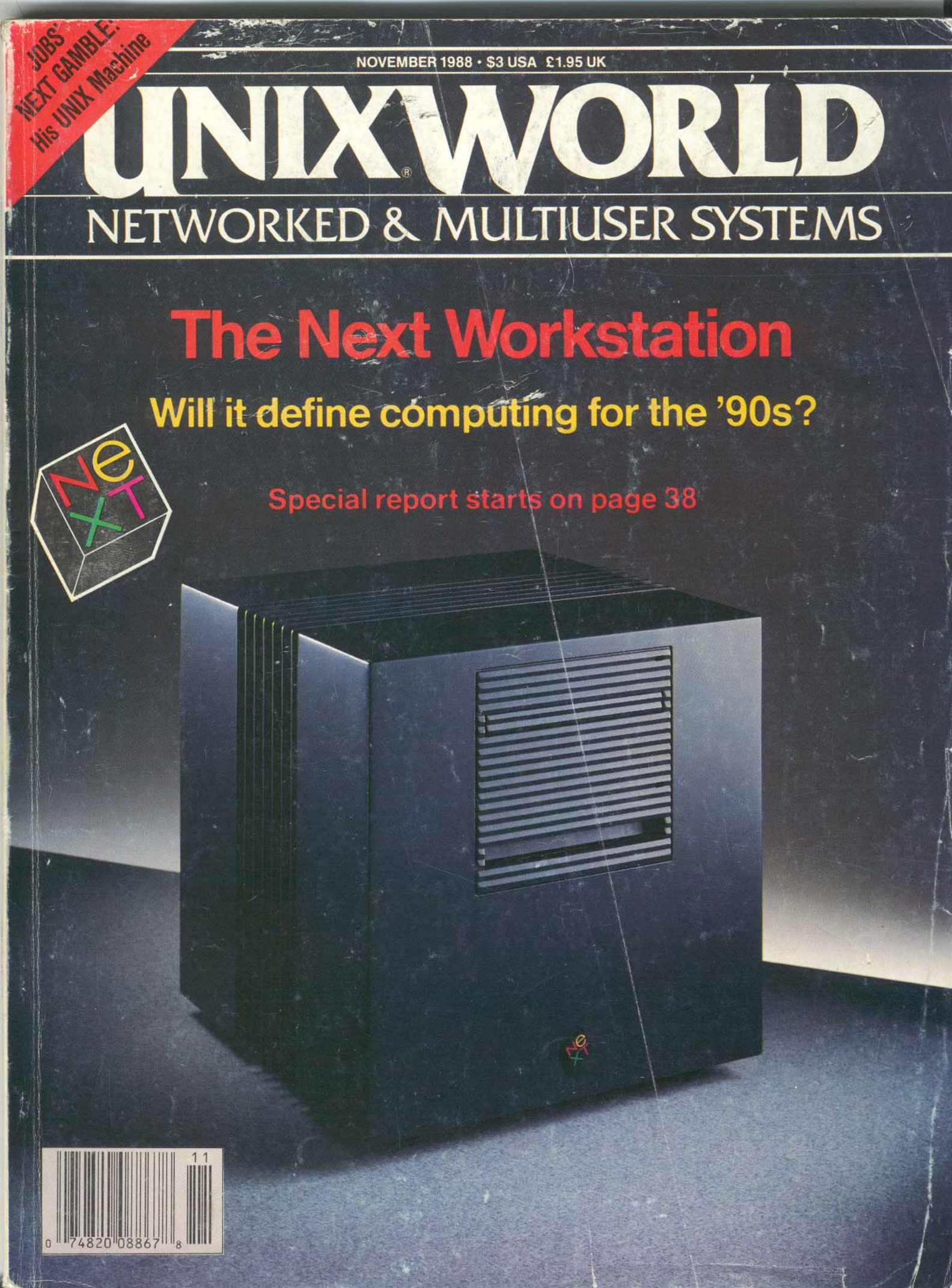
# UNIX® WORLD

## NETWORKED & MULTIUSER SYSTEMS

# The Next Workstation

## Will it define computing for the '90s?

Special report starts on page 38



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# READY FOR WHAT'S NEXT?

*Steve Jobs gambles that the Next workstation will define computing for the 1990s*

*By Michael Jay Tucker*

This October, Next Computer Inc., the company founded by Steven Jobs and a group of his close associates, is scheduled to introduce the long-awaited, much-rumored Next workstation. The new system is among the most radically innovative desktop computers to be introduced in the last five years.

Among many other things, the Next system boasts:

- An operating system that is neither System V nor 4.3, but Mach.
- A Motorola 68030 CPU vastly augmented by a mainframe-like arrangement of dedicated I/O processors.
- An integral floating point processor and a powerful digital signal processor that give the workstation an unsurpassed capability of dealing with such analog phenomena as voice and video.
- A mass storage system that is nothing less than the first erasable, read-many and write-many optical disk system on the commercial market.

It is, in short, both a new product and a challenge to accepted practice in the PC and workstation industry.

Perhaps not since the original Apple Macintosh gave us 3½-inch disk drives and icons have so many innovations been packed into a single introduction.

The question now for the industry, and for Next, is whether these are the technologies the market wants. If so, then the Next workstation could define what personal computers must be in the 1990s.

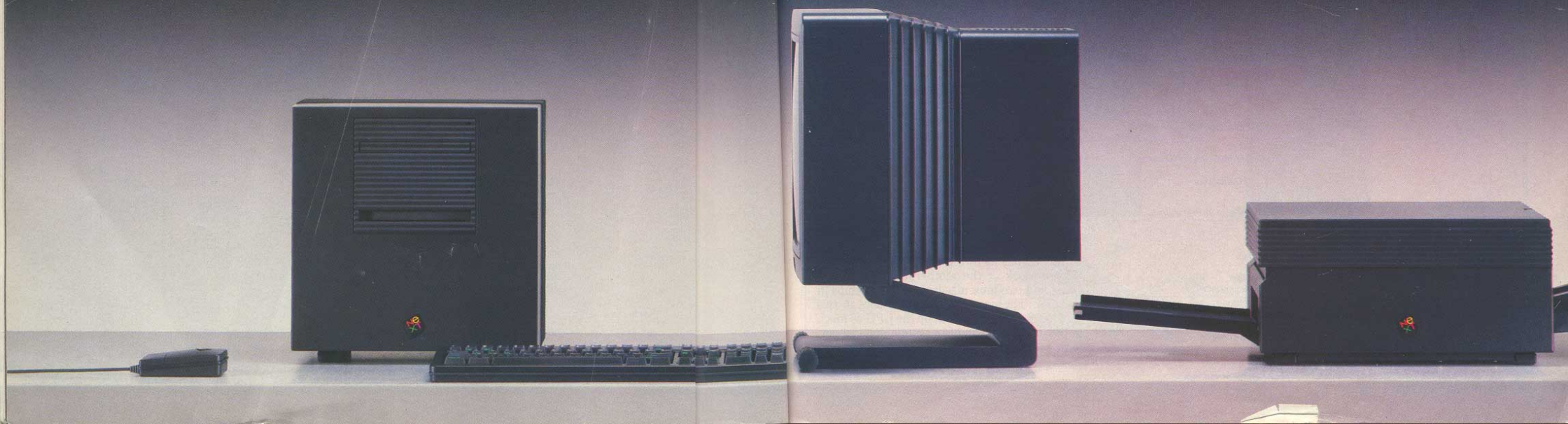
UNIX WORLD was shown the system under strict conditions of nondisclosure in late August. That way we met our deadline to have the story printed in conjunction with Next's official introduction of the machine, scheduled to take place in October at Davies Symphony Hall in San Francisco.

From a hardware perspective, the Next workstation is unique even at first glance. Next chose to avoid both the standard desktop and deskside configuration for what company President Steve Jobs calls "a modified tower configuration."

This means that the computer is contained in a one-foot-square cast magnesium cube that can be placed up to 10 feet away from the monitor and keyboard. The machine connects to the monitor via a single cable, which in turn connects to the keyboard via a single cable. Power and data links are both provided in a single connection, and the individual parts of the system join as neatly as boxcars on a single track. The result is a system that goes far to overcome the cable clutter that is the norm for most personal systems.

The monitor, which Next calls "the Megapixel Display," is a large-screen (17-inch) monochrome display. Rumors had held that the Next system was going to make extensive use of color—rumors fanned when Next purchased a large part of Pixar from Lucasfilms last year. And, in fact, color systems are planned for the near future. But Next has chosen instead to focus on extremely high resolution—1120 by 832—the goal being "megapixel," or a million dots per screen. The resolution is so high that the monitor neatly handles photographs without difficulty. "We decided that we believe more in megapixel than in color," says Jobs.

The keyboard is standard in size and shape, though somewhat sleeker and more futuristic in design than most. Attaching to the keyboard by a single connection is a standard two-button mouse.




The monitor housing contains a number of surprises, not the least of which are speakers and a microphone. This is less unusual when you remember that the original Macintosh has gradually become the PC of choice for sound engineers working in the low end of the recording industry. The Next workstation can clearly address the same market, should Next ever wish to take it there. The Next machine can be used by itself as a music synthesizer to produce what the company calls "CD-quality sound."

On the rear of the monitor are a battery of ports and interfaces. In addition to the connection for the microphone, these include plugs for a set of earphones and two standard jacks for connections to stereo systems.

But it's in that jet-black cube of the computer housing that things get really interesting. Open it up, and you'll find that in the raw state, it is mostly empty. The whole of the Next system fits on a *single* board. There is room for another three peripheral or CPU boards within the box. There is, in short, no reason why the Next workstation couldn't be a multiprocessor or even parallel processing machine—which is one reason that the company went with the Mach version of UNIX.

Mach is a version of Berkeley UNIX 4.3, developed at Carnegie-Mellon University with the Defense Advanced Research Projects Agency (DARPA). It is designed to provide support for multiple processors inside a workstation or along a network and has been used most frequently in American multiprocessor systems. BBN Advanced Computers, for instance, recently introduced a version of Mach for its Butterfly multiprocessor. (More information on Mach appears later in this article.)

Both the board and the bus into which it fits are unique. Next boards are, quite simply, big. They're nearly 11 inches square—almost three times the size of a normal rectangular PC board.

That increase in size is no accident. The Next designers deliberately wanted a board size and a board shape that allow third-party developers to produce as complex a system as possible. Next people envision third parties producing boards containing entire systems rather than simply the subsystems to which PC boards are usually limited.

The Next bus, meanwhile, is like nothing in the PC market today. It is a proprietary 32-bit bus developed by Next itself. But it is also to be open. Next says it will license the specs for the bus to virtually any board vendor that wants them. Moreover, according to Jobs, Next will sell those vendors its own bus controller ICs for $25 a chip.

Extract the motherboard from the Next system and you find yourself holding a surface-mount system based on a Motorola 68030 32-bit processor. Next people say that they went with the 68030 rather than a RISC chip—such as Motorola's 88000—for a number of reasons, not all of them technical. "At least we knew we could get the chip," said one design engineer, "which wasn't clear about the 88000 when we started the design process." However, Next leaves open the question of whether it might later go to a RISC chip.

But the processor is only part of the story. The Next system can manage 3 to 5 mips, essentially three times the speed of a DEC VAX 11/780 and comparable to the Sun 3 family of workstations, where mips range from 1.5 to 4. But Next's staff is unusual in that they're not mips freaks. The company looked at performance issues in workstations and found that, says Jobs, "mips is only 25 percent of the equation, if that." As important as the processor's speed is how much of its time is spent on I/O—from peripherals, RAM, and so on.

Next decided to address the issue by offloading I/O tasks. In particular, it copied a technique developed on mainframes, where each peripheral has its own dedicated I/O processor.

Thus, look at the motherboard again and you'll find two muscular-looking VLSI chips in a corner. These are 12 I/O processors in two packages, prepared to free up the CPU as much as possible. The result is a system that can perform as though it contained a much more pow-

**NEXT WORKSTATION PRICES AND CONFIGURATIONS**

| | |
|---|---|
| **Basic System** | |
| Next Workstation with 4 MB RAM, optical disk drive (256 MB), and bundled software * | $4995 |
| **Optional Equipment** | |
| Next laser printer (8 ppm/400/300 dpi) | $1995 |
| Winchester drive (670 MB) | $3995 |
| Second optical drive (256 MB) | $1495 |
| Extra 4 MB RAM | $1495 |
| **Media** | |
| Optical disk media | $ 50 |

*Bundled software:

System Software
- Mach operating system
- PostScript window server and fonts
- System administration tools

Development Tools
- GNU C compiler, debugger, and Emacs
- Objective C 4.0 (The Stepstone Corp.)
- Berkeley UNIX utilities
- Terminal emulator

Object-Oriented Software Kits
- Application kit (graphical user interface objects)
- Sound kit
- Music kit

High-Speed Text Retrieval Application For

Standard Reference Works
- Merriam-Webster's *Ninth Collegiate Dictionary* and *Thesaurus*
- Oxford *Dictionary of Quotations*

Literature
- Oxford *Complete Works of Shakespeare*

Applications
- Personal text database
- Graphical electronic-mail
- Word processor
- Window-based file manager
- Mathematica (Wolfram Research Inc.)

Note: Prices provided by Next were stated to be for "higher education" and were current as of 9/15.

erful CPU—simply because what processor power it has can be dedicated to processing rather than communications.

## THE DIGITAL SIGNAL PROCESSOR

Look further on the board and you'll find a floating point chip and—surprise!—a 10-mips Motorola digital signal processor (DSP).

A DSP is a dedicated matrix algebra machine. It can run very large matrix calculations very quickly. As a rule, these processors show up in applications where large amounts of analog data must be dealt with in a hurry and in a digital setting. Modems, real-time laboratory test and measurement equipment, voice synthesizers, video postproduction facilities, neural network emulations—all these and more are DSP markets.

In fact, there is a small cottage industry devoted to the production of DSP-based boards for PCs and Macintosh systems. But the Next system includes that kind of power as a given—which is why the workstation is also a musical instrument and can be its own modem. It's also why the Next system can be used to do voice mail. Next boxes can take speech, code it as an ASCII file, and dispatch it to other Next machines, where it is turned into sound.

Thus, the Next workstation could be used in the raw state for a set of applications that before could be done only with heavily modified PCs or low-end workstations. Or, with additional hardware, the Next workstation could be used for situations that today are addressed by much more costly machines—such as midrange workstations.

This could be important, given Next's stated market—the academic and research worlds. It is in those communities that signal processing, analog-to-digital conversion, real-time measurement, and so on are particularly important. And thus it's no surprise that one of the first demonstration programs written for the machine was a virtual oscilloscope.

Beyond the digital signal processor, the board supports up to 16 megabytes of dynamic random access memory (DRAM). Next says, by the way, that DRAM supplies are not a problem. The firm needed only a few DRAM chips for initial designs and has locked in domestic suppliers for when it begins full production in October.

When it does go into production, Next will do so with a robotic work force. Next will do its manufacturing in an automated plant in Fremont, Calif., and the entire motherboard will be produced by machine.

If you look at the back of the Next machine, you'll find a host of connections and interfaces. The back sports a SCSI port, two Macintosh-compatible serial ports, a DSP port, an Ethernet connection as well as connections for the monitor and Next's laser printer.

## BETTING THE COMPANY

What may be the most remarkable aspect of the Next workstation is its mass data storage. The workstation contains an erasable optical disk system—the first of its kind on the market.

Jobs notes that when Next went into its design process, it considered and rejected virtually every form of removable mass storage on

**THE NEXT WORKSTATION BOASTS THE FIRST ERASABLE, READ-MANY AND WRITE-MANY OPTICAL DISK SYSTEM ON THE COMMERCIAL MARKET**

the market. Each seemed too bulky, costly, or unreliable for the "educational market" Next says it wants. Whatever the Next system used had to be able to hold large amounts of data yet be as portable as any floppy and be inexpensive enough that graduate students could afford it.

"So two years ago," Jobs says, "we made a bet-the-company decision." Next decided to gamble on a fully read/write optical disk—a technology that did not exist outside a few laboratories at the time—in the hope that the drive would be ready to produce in commercial quantities in time. "And," says Jobs, "we won."

Next pioneered the development of the technology with a partner that it will not identify. Next's people will, however, show you the disks. Each is 5¼ inches in diameter, but fits into a slightly bigger hard plastic cartridge. Based on an optical-magnetic technology, the disks can be written to, erased, rewritten, and generally used exactly as a magnetic disk would be used, but without such disadvantages of magnetic media as crashable read/write heads. Each disk has a capacity of 256 megabytes but costs only about $50. It thus provides the storage of a Winchester, but it can be removed and carried "in the average backpack" like a diskette.

As another option, Next will be happy to install up to two standard Winchester disk drives in the system. Various tape backup systems can also be had.

But a storage system is meaningless without something to store—like software. And, here too, Next has been busy. The workstation is clearly intended to be a developer's machine par excellence.

## THE INTERFACE

Boot the machine, and you see first Workspace, Next's graphically oriented front end to UNIX. Like the Mac interface or Microsoft's Windows, Workspace makes extensive use of pull-down menus, icons, and multiple windows. However, by accident or design, the Next interface does *not* look like the Mac's. Workspace will be difficult to entangle in the look-and-feel issue.

Workspace can be as ordered or as chaotic as you like. Windows can open and close. Material can be cut and pasted between windows. Windows and their associated processes can collapse into icons. Menus pop up, Sidekick-fashion, or vanish, as the user directs. Or menus can be made to float, in a sort of weightless fashion, to keep them on-screen and accessible but out of the way of important work.

The icons reside in "docks" in the "miniworld," a dedicated area on the right side of the screen. They can be moved from here and be buried under other icons or open windows, but they always return to their port when commanded to do so. This neatly avoids the confusion that plagues a lot of icon-based interfaces.

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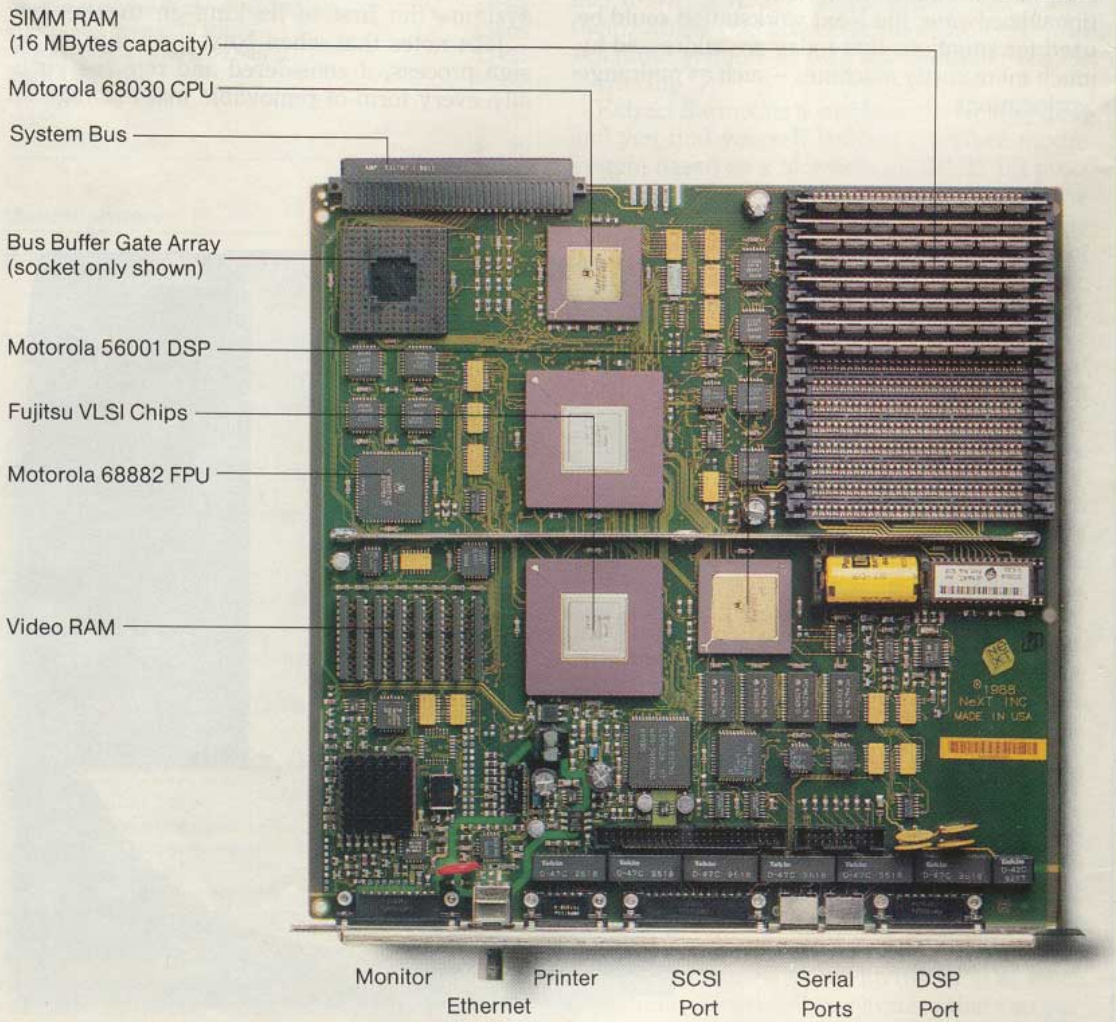
**THE NEXT WORKSTATION'S MOTHERBOARD**



Icons can also be associated. You can provide logical connections between, say, one application and another or between different databases. In this way, Workspace takes on a bit of a hypermedia flavor. In fact, Jobs says that this design reflects Next's general disappointment with strictly icon-based systems.

An interface is only the frosting on larger software architectures. Workspace is no exception, and it is the top-most layer of Next Step, Next's proprietary software architecture. Next Step is the entire collection that resides between Mach and the user.

Workspace rests atop a layer of software known as the Interface Builder. This is effectively a toolkit to allow developers or even semi-skilled users to build graphically oriented interfaces for their own applications. Again, there is a taste of Hypercard here. The Interface Builder provides a host of predesigned and predefined images that anyone, not necessarily a programmer, can use.

## THE APPLICATIONS KIT

Below the Interface Builder is something called the Applications Kit. If the Interface Builder is aimed at users, then the Applications Kit is meant for programmers. It is a collection of objects—reusable code modules that developers can use or discard as they wish.

These objects aren't just subroutines but are significant programs in their own right. "We provide spec sheets for each module," says Bruce Blumberg of Next technical services, "exactly as though it were a piece of hardware." Developers can use the objects unmodified, as though they were black boxes, or they can customize the code.

Currently, they are 25 such objects in the kit, but more are coming. Next will also encourage third parties to write and sell such objects to other developers. Some of the objects currently in the Applications Kit are a windows object, a text object, a collection of "buttons" that developers can use in their interfaces, and so on.

Each of Next's objects is written in Objective C, the object-oriented version of the C language from Stepstone Corp. This represents a significant design decision on Next's part. Much of the rest of the UNIX world has settled on C++ as the object-oriented C of choice.

Why did Next select Objective C over the industry leader? Next people say that Objective C's ability to do run-time binding was the chief reason. (Run-time binding gives programmers a number of advantages, including the ability to link software objects at a much later stage of development.)

In any case, Next envisions the Interface Builder and Application Kit being used together, but perhaps by different people. The plan is that users—who are quite familiar with their own particular needs but not necessarily with computer technology—would use the Interface Builder to design the application. Then a programmer would use the Application Kit to put together the code that would run under the interface.

## WINDOW SERVER AND DISPLAY POSTSCRIPT

As we descend into Next Step, the level below the Application Kit contains two types of software—Window Server and Display PostScript. This is the final level of Next Step, the one that resides just above the operating system, and it is here that Next's own software gets closest to the hardware.

The screen is controlled via Display PostScript. Next is one of those rare companies that believes the screen ought to be run by the same layer of software that controls the printer.

Window Server, in turn, is software that contains a Display PostScript interpreter and that provides the link between the interpreter, the

### Next's X-less connectivity

If connectivity is the cry of computing in '88, then for workstation windowing standards, X has been the echo that came back. With the majority of the workstation industry supporting X Windows, why did Next decide to create its own proprietary windowing server?

For Steve Jobs and company, it's a technical issue. In his keynote address at the 1987 summer Usenix conference, Jobs said, "I think X Windows is brain-damaged and will fail." Clearly, Next had decided early to forgo the window standard funded by IBM and DEC, known as the Athena Project at MIT.

According to Bruce Blumberg, technical adviser, Next's decision to create its own windowing server goes back a couple of years when an early, less-developed version of X was being considered. "At the time," Blumberg notes, "X had its own imaging model, and there was no ability to support PostScript."

Hinting at things to come, Jobs also said at Usenix that Adobe's PostScript was destined to be a display-imaging standard, as well as a printer language. "X was designed to be highly portable, and this resulted in a compromise in performance," says Blumberg. Specifically, he mentions technical problems about the early version of X, including "response latency" and "failure to guarantee maintenance of window buffers" as problems that Next believed would inhibit the high level of performance it sought.

Next supports NFS and TCP/IP over thin Ethernet. These standards allow transparent file sharing among dissimilar computers. In a network made up of workstations from various manufacturers, all users can share files with this level of standards.

What X Windows provides is the ability for each user to see applications that are running on other systems, regardless of manufacturer or even operating system. For example, with X Windows, workstations from Sun, Apollo, IBM, H-P, and Digital could all share windows that show applications running on any workstation on the network. Without X Windows, not only can Next applications be run only on another Next computer, but they can be seen only on another Next computer.

At press time, Next had not revealed whether third-party developers would offer any windowing solutions that would permit Next applications to be viewed across a network of X Window-based systems. In the past, Sun Microsystems has supported X Windows in addition to its own PostScript-like News product, and DEC recently adopted the PostScript imaging model for its DECwindows implementation of the X Window standard. Perhaps Next too will eventually come around to X. —*Dave Flack*


screen, and input devices—like the keyboard, the mouse, and so on. "Everything you see on the screen is ultimately drawn as the result of an application process sending PostScript down to the window server," says Blumberg. "When the server detects, for example, a mouse-down, it will figure out which application owns the window and dispatches the event off to an object in that window."

As you go below the Window Server, you drop off Next Step and into the operating system—Mach.

Why Mach? Why take as an operating system a 4.3-like version of UNIX that is far removed from both the major standards in UNIX and that has links with neither AT&T nor the Open Software Foundation?

"We love Mach," says Jobs, "not because it is like 4.3 but because it has a beautiful, elegant little kernel with an interprocess communication mechanism that runs 7 to 10 times faster than regular UNIX. The promise of Mach is that it takes a lot of things that are in the kernel in regular UNIX and puts them in the user processes—communications, for instance, and you could put your file system in a user process. Once they are there, they can be maintained by regular programmers, people you can find, rather than kernel gurus."

But this doesn't necessarily mean that Next is wedded indivisibly to Mach, or anything else. If some other version of UNIX provides similar functionality, and if customers demand it, Next says it will move to whichever UNIX that might be. "We are fundamentally nonreligious," says Jobs. "We will go whichever way the world does."

## THE LASER PRINTER

Next has one more surprise up its sleeve. Not only has the company designed a new system but it has also produced a $2000 personal laser printer to go along with it. The printer manages to be so cheap because much of the electronics that a normal laser printer would contain are unnecessary. The processing that another printer would have to perform by itself is handled instead in the Next workstation by, often as not, the very PostScript interpreter that handles the screen.

The sum of all this is a machine that could compete with the low end of Apollo's or Sun's product line rather than the top of the PC world. Yet its total price is roughly $5000, or $7000 if you include a printer.

But as owners of $50 PCjrs across the country can testify, a machine, no matter how aggressively priced, is useless without applications. The Next machine, although new, is a wee bit short of those.

Yet the Next box *is* a development machine, and Next is courting developers with a passion. Moreover, it has produced a few applications of its own, in much the same way, says the company's vice president of sales and marketing, Dan'l Lewin, that the Apple Mac came with MacWrite and MacDraw, more as demonstrations than anything else.

With the workstation, Next is bundling an editor and what it calls "electronic directories." The entire *Webster's Dictionary* is already on the system, for instance. It includes not only the definitions of words but also photographs, drawings, and so on. There's also a *Webster's Thesaurus* on the system, an Oxford directory of quotations, and a complete edition of the collected works of Shakespeare.

There's also the WriteNow word processor (originally written for the Macintosh), an e-mail facility (the one with voice capacity), and a small personal database, currently named Jot.

For developers, meanwhile, there's a C compiler, several editors, Objective C, and an assortment of subroutines that the company calls specialized "kits." For the digital signal processor, for instance, there is a sound kit, an array processing kit, and a music kit. It's the music kit that holds the sounds of different synthesized instruments. The kit already contains a small orchestra of musical instruments, and, Jobs notes, "We'll be adding a few more every few months."

**Jobs on Mach: 'We are fundamentally nonreligious. We will go whichever way the world does.'**

And if there isn't much software already in the can for the Next machine, it isn't difficult to envision lots of interesting things one could do with it. Molecular modeling, library applications, image processing, video postproduction, full text retrieval systems, neural networks, and so on could all be managed with the device rather easily. Next people also like to talk about "simulated learning environments" for schools. "It isn't possible to give every student a genetics lab," says Lewin, "but it is possible to give each student access to a Next machine," and then simulate labs on the workstations.

## THE BLACK BOX GOES TO SCHOOL

The main criticisms of the original Macintosh were that it was user friendly but programmer hostile and that it could be expanded with nothing short of a warranty-voiding can opener.

Next, the company, seems almost fanatically determined that Next, the workstation, will not share those characteristics. The Next workstation is as expandable as an erector set and as programmable as an alarm clock. If the machine catches on, it could have as exciting an aftermarket as, say, the PC did before the PS/2. Board makers in particular may find the Next's 11-inch boards a rewarding and liberating departure from the PC's more cramped quarters and the PS/2's more serious licensing fees. Software developers, meanwhile, might find that the Next Applications Kit and Interface Builder are everything that Hypercard was supposed to be.

Initially, though, users will be the Next machine's real support group and third-party development community. The Next workstation is to be sold into the universities (see the accom-

panying article on Next's marketing plans). That's partly because the educational market is one that few companies (Apple among them) have really addressed.

But, says Next, the academic setting is also a sort of boot camp where new computers go to grow in a hurry. The computing needs of academic users, explains Jobs, "are a superset of the rest of the world. They are pushing the envelope at almost every step. So when you make a computer that meets higher ed's requirements, you end up making a machine to meet a lot of other people's requirements too. There's no other market that's going to collaborate with you like that. There's no other market that's going to push you as hard." □

*Michael Jay Tucker is this magazine's East Coast Editor. Based in Boston, he has followed the computer industry for five years.*

# BETTING THE COMPANY ON HIGHER ED

*By Dianne Jacob*

*Next says it will prove itself in education first, but plays coy about moving into the business market*

Next positions its machine as exclusively dedicated to the needs of higher education. Does that mean the Next workstation won't be sold to business users?

"Not in the first three to six months," says Dan'l Lewin, vice president of sales and marketing. He adds that there is no plan at present to sell to any market other than higher education. Expansion plans are limited to establishing a sales office in Canada soon.

A program for third-party vendors will begin in November, says Lewin. As we go to press, Next would not release the details of any agreements with third-party vendors, saying only that "big-name software vendors make sense" and that the company's strategy is to work with 10 to 12 leaders in the field.

Why pick the higher education market? From a technical perspective, Next says it's a more daring market in which to develop the ultimate machine. This market is more technically demanding than the business community, says Steve Jobs, and if the workstation is accepted in higher ed, chances are it will be accepted in the workplace as a whole. The educational community is also less interested in standards. From a sales perspective, higher ed is a less competitive market than traditional UNIX markets such as engineering, business, and federal government; and for now, Next would be happy with a piece of that higher ed market. And from the perspective of the founders of Next, who are all Apple Computer expatriates, perhaps it's because it's what they know best.

Keep in mind that investors in Next, aside from Jobs and H. Ross Perot, are Stanford and Carnegie-Mellon Universities, with one-half percent each.

## MARKETING STRATEGIES

Traditionally, the marketing strategy of computer companies such as Apple, DEC, and IBM has been to give or heavily discount machines to higher education as gifts, hoping that once students used the machines, they would request the same computer once they entered the work force. Now Apple's Mac II, Sun workstations, IBM PCs, and DEC Micro-Vaxes are on the desks of colleges and universities. Next is banking on higher education's willingness to pay for the machines it wants, rather than be stuck with gifts that cannot do the job.

Next says it will sell directly to universities, which will buy, resell, and support the machines under a partnership agreement. The school, the faculty, and the student are targeted buyers. The Next workstation will be sold directly, not by any dealers or distributors. Volume purchasers may receive extra training and support in lieu of a heavily discounted price.

**If the Next workstation is accepted in higher ed, chances are it will be accepted in the workplace as a whole.**

The price of the Next workstation with 4 megabytes of RAM is about $5000, compared with around $9400 for Apple's new 68030-based Mac IIx with an 80-megabyte hard drive and floating point co-processor, or an $8900 Sun 3/60 68020-based diskless workstation with 4 megabytes of memory.

When Next compares the machine to a Mac II, the comparison is made at the low end; when Next compares its workstation to a Sun workstation, then markets like computer-aided software engineering (CASE), computer-aided design, and technical publications are mentioned. Dataquest Corp. defines a technical workstation as a complete standalone computer system with integrated graphics, integrated floating point processor, distributed networking, windows, keyboard and mouse, and demand-paged virtual memory architecture.

*continued*

Vicki Brown, a senior analyst at International Data Corp., says the 1987 worldwide market for technical workstations from U.S.-based vendors was worth about $2.6 billion, and that higher education accounted for 15 percent of all revenues. Last year Sun took 28.9 percent of the total workstation market, then Apollo with 21.2 percent, DEC with 20 percent, Hewlett-Packard with 11.5 percent, and Silicon Graphics with 4.5 percent. Brown estimates the total 1988 technical workstation market to be worth $3.9 billion; higher ed's 15 percent share of that market would be worth $585 million.

### NEXT'S TARGET

As for the actual size of the Next infiltration, Lewin says that within a year to 18 months, he expects Next machines to lead the installed base of technical workstations in the higher education market—a market, he says, that now totals some 20,000 machines. He declined to give figures on projected production runs.

Target customers run the gamut from the most sophisticated at one end—professors and commercial users, campus developers, courseware developers, and expert users who want to customize applications—to those using the workstation for word processing and spreadsheets. Lewin says there are around 12.5 million students in U.S. higher education, and at least 1 million faculty and administration users.

One of the few outsiders to see the machine before its introduction is Ron Weissman, director of Academic Computing at the University of Maryland. Weissman, who has been working with Next since its inception, says he is impressed that the machine is "one of the first workstation products that address the PC market at close to PC prices with uncompromised functionality."

That view is shared by David Grady, author of "The Grady Report: Personal Computers in American Education," who says there is no "across-the-board" market leader in the higher education market. "Sun isn't trying to sell to the English Department," he explains.

Weissman says that Next is also the first to offer a UNIX machine where "the selling point is not UNIX," adding that UNIX is "incidental to the end user." He says his school is planning to purchase the machine so faculty members can do research.

Steve Jobs has another answer to the question, Why UNIX? Jobs firmly believes that in the 1990s "every computer will run UNIX as its primary operating system." His task at Next, he says, is to make "UNIX for mere mortals."

*Dianne Jacob is this magazine's Executive Editor.*

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